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SOME AMERICAN CONTRIBUTIONS TO TECHNICAL CHEMISTRY.[*]

THE inventive genius of the American people is universally conceded. The necessity of accomplishing things quickly, incidental to the growth of a new country, such as ours, has naturally led to the invention of many forms of labor-saving machinery, and so with improved appliances have come improved methods. The technical chemist is, however, less fortunate than his brother in the professorial chair whose merits are made known by his students, thus attracting an ever-increasing following to his laboratory, and perhaps he is also less fortunate than his associate who devotes himself to research work; for to him are given medals and honorary memberships which are properly the 'blue ribbons' of science; hence it is that the discoveries of the technical chemist, especially where they are commercially meritorious, remain too frequently unknown, and the profits of the improvement go to swell the dividends of the corporation to which he owes his allegiance while he receives no public recognition. It naturally follows, therefore, that any summary of the achievements in the development of technical chemistry must be very incomplete.

To say when chemistry begins is not generally possible, for its origin wanders back into alchemy and pharmacy on the one side and into physics on the other, and there are no sharp lines of separation among the

[*] An address delivered before the Congress of Arts and Science, St. Louis, September, 1904.

various branches of science, for they gradually merge one into the other. In this country, however, we have grown to accept the date of the arrival of Joseph Priestley, June 4, 1794, as a most excellent time at which to begin the modern history of chemistry.

The younger Silliman's masterly 'American Contributions to Chemistry'* gives me the right, therefore, to mention first Benjamin Thompson, Count Rumford (1751–1814),† whose studies in heat and fuel were as practical as they are important. His early knowledge of science was acquired from John Winthrop (1717–1779), who held the chair of mathematics and natural philosophy at Harvard from 1738 till his death. Of Count Rumford I have said elsewhere:‡ 'He investigated the properties and management of heat, and the amount of it that was produced by the combustion of different kinds of fuel, by means of a calorimeter of his own invention.' By reconstructing the fireplace he so improved the methods of warming apartments and cooking food that a saving of fuel of almost one half was effected. He improved the construction of stoves, cooking ranges, coal grates and chimneys, and showed that the non-conducting power of cloth is due to the air that is enclosed in its fibers. Silliman well says of him: 'No writer of his time has left a nobler record of original power in physical science than Rumford.' It will also be remembered that by will he provided funds 'to teach by regular courses of academical and public lectures, accompanied by proper experiments, the utility of the physical and mathematical sciences for the improvement of the useful arts, and for the extension of the industry, prosperity, happiness and well-being of society.'* Let me also remind you that Wolcott Gibbs, the oldest and now the Nestor of American chemists, held the Rumford chair in the Lawrence Scientific School of Harvard from 1863 till 1888, during which time many of those who are now leaders in chemistry were students under him.

The last century was only a year old when Robert Hare (1781–1858) communicated his discovery of the oxyhydrogen blowpipe to the Chemical Society of Philadelphia. This instrument held a foremost place for the production of artificial heat until the recent introduction of the electric furnace. The application of the principle invented by Hare still finds extensive use for lighthouse illumination and similar purposes under the names of 'Drumond light' and 'calcium light.' It is interesting to recall in this connection that Hare was the first to receive the Rumford medals from the Academy of Arts and Sciences.

Hare was also the inventor in 1816 of a calorimotor, a form of battery by which a large amount of heat was generated, and four years later he modified this apparatus, with which, then known as Hare's deflagrator, in 1823 he first demonstrated the volatilization and fusion of carbon. His memoir on the 'Explosiveness of Niter,' which was published by the Smithsonian Institution in 1850, was one of the earliest contributions by an American to the literature of explosives.†

The original discovery of chloroform is clearly of American origin and must be

* *American Chemist*, V., 1874, p. 70.

† See 'Memoir of Sir Benjamin Thompson, Count Rumford, with Notices of his Daughter,' by George E. Ellis, also 'Complete Works of Count Rumford,' 4 Vols., published by the American Academy of Arts and Science (Boston, 1876).

‡ 'Cyclopædia of American Biography,' V., p. 345, article Rumford, Benjamin Thompson, Count.

* *American Chemist*, V., 1874, p. 73.

† 'Smithsonian Miscellaneous Collections,' II., 1895. Also see the memoir of him by the elder Silliman in the *American Journal of Science* (2), XXVI., 1858, p. 100.

credited to Samuel Guthrie (1782–1848), of Sacketts Harbor, N. Y., whose researches anticipated those of Soubeiran, Liebig and Dumas by nearly a year.

A committee of the Medico-chirurgical Society of Edinburgh gave him the credit for having first published an account of the therapeutic effects of chloroform as a diffusive stimulant. Dr. Guthrie was likewise the inventor of a process for the rapid conversion of potato starch into sugar. He also experimented with considerable boldness in the domain of explosives, inventing various fulminating compounds, which he developed commercially.*

It would be an ungracious task to discuss in this paper the much-controverted 'ether discussion,' but I may say, without fear of doing injustice to any of the several claimants for the honor of the discovery of this important anesthetic, that Charles Thomas Jackson (1805–1880), said to be one of the foremost chemists of his time in this country, claimed from experiments made by himself during the winter of 1841–2 in his own laboratory, that he obtained results showing 'that a surgical operation could be performed on the patient under the full influence of sulphuric ether without giving him any pain.' Four years later (in 1846) this was successfully accomplished by Dr. William T. G. Morton, who had studied chemistry in Dr. Jackson's laboratory. The French Academy of Sciences decreed one of the Montyon prizes to Jackson for his discovery of etherization, and one to Morton for his application of that discovery to surgical operations.†

Metallurgy is little more than the application of chemical knowledge to the extraction of metals from their ores, and I, therefore, beg to claim for the United States the first commercial production of steel. Zerah Colburn, the well-known engineer, gives William Kelly (1811–1888), an iron master of the Suwannee furnaces of Lyon County, Ky., the credit for the 'first experiments in the conversion of melted cast iron into malleable steel by blowing air in jets through the mass in fusion.' Later, when Sir Henry Bessemer made efforts to secure the patent of the process that bears his name, it was decided by the U. S. Patent Office that William Kelly was the first inventor and entitled to the patent, which was promptly issued to him. In 1871, when application was made for a renewal of the patents originally issued to Bessemer, Mushet and Kelly, the last was successful, while the claims of the first were rejected.*

The successful electro-deposition of nickel and its commercial development are chiefly due to the energy of Isaac Adams (1836–), a resident of Cambridge, Mass. He carefully studied the subject and found that the failure to obtain satisfactory results was caused by the presence of nitrates in the nickel solutions previously used. His invention gave rise to prolonged litigation, but in the end he was victorious. Dr. Chandler thus describes it in the fol-

* An account of his career has been published in pamphlet form by his descendant, Ossian Guthrie.

† Dr. Jackson published a 'Manual of Etherization with the History of this Discovery' (Boston, 1861) and much interesting information is to be had from a 'Report of the House of Representatives of the United States of America, vindicating the rights of Charles T. Jackson on the Discovery of the Anesthetic Effect of Ether Vapor.' The other side of the controversy is given in 'The Discovery of Modern Anesthetics: By whom it was made?' by Laird W. Nevius, New York, 1894.

* Much has been written of the claims of Kelly and nearly all of the leading American metallurgists agree in conceding his priority. Swank and various writers in the *Transactions of the American Institute of Mining Engineers* may be consulted. Kelly's own story, as he gave it to the present writer, appears in the *Iron Age*, February 23, 1888, p. 339.

lowing words: "The novel proposition was presented to the court, of a patent for not doing something, namely, for not permitting nitrates to find their way into the nickel solutions employed in nickel plating, and the court held that the exclusion of nitrates was an essential condition of successful nickel plating, and that a process involving this condition was just as patentable as a process involving any other special condition necessary for successful execution, and the patent was sustained."*

In passing I may mention the name of Joseph Wharton (1826–), whose experiments in producing nickel in a pure and malleable condition so that it could be worked like iron culminated in the first production in 1865 of malleable nickel.

Chemistry owes a great debt of gratitude to the genius of Thomas Sterry Hunt (1826–1892) and one of his most notable contributions to technology is the permanent green ink which he invented in 1859 and which is used in the printing of our national bank notes and from the appearance of which the well-known term of 'greenback' was derived. The Hunt and Douglas process for the precipitation of copper by iron, for a time so extensively used for the extraction of copper from low-grade ores, is an invention the credit of which he shares with the well-known metallurgist, James Douglas.

The vulcanization of india rubber by sulphur is the invention of Charles Goodyear (1800–60), who was so persistent in his efforts as to become an object of ridicule. Indeed, he was called an india rubber maniac and was described as a 'man with an india rubber coat on, india rubber shoes, and in his pocket an india rubber purse, and not a cent in it.' His invention consisted in mixing with the rubber a small quantity of sulphur, fashioning the articles from the plastic material and curing or vulcanizing the mixture by exposure to the temperature of 265–270° F.*

Of almost equal importance was the invention of hard rubber or vulcanite, for which Nelson Goodyear (1811–57), a brother of Charles Goodyear, obtained a patent in 1851, claiming that the hard, stiff, inflexible compound could be best obtained by heating a mixture of rubber, sulphur, magnesia, etc., but this never became an article of commerce. In 1858 Austin Goodyear Day (1824–89) patented a mixture of two parts of rubber and one of sulphur, which, when heated to 275–300° F., yielded the flexible and elastic product now generally known as hard rubber.†

Dr. Leander Bishop has said: 'In the art of modifying the curious native properties of cautchouc and gutta percha, and of molding their plastic elements into a thousand forms of beauty and utility, whether hard or soft, smooth or corrugated, rigid or elastic, American ingenuity and patient experiment have never been excelled.‡

Exceedingly valuable to the industries of this country was the influence of James Curtis Booth (1810–88), who from 1849 till his death was melter and refiner in the U. S. Mint. In 1836 he established a laboratory in Philadelphia for instruction in chemical analysis and chemistry applied to the arts, and in the course of a few years gathered around him nearly forty students, among whom were Martin H. Boyé, John F. Frazer, Thomas H. Garrett, Richard C. McCulloh and Campbell and Clarence Morfit, all of whom have achieved eminence as chemists. It was said of him, 'that Mr.

* *Journal of the Society of Chemical Industry*, XIX., 1900, p. 611.

* His life has been published by Bradford K. Peirce with the title, 'Trials of the Inventor,' New York, 1860.

† *American Chemist*, II., 1872, p. 330.

‡ 'A History of American Manufactures,' by J. Leander Bishop (Philadelphia, 1860).

Booth had few, if any, superiors as a teacher of practical chemistry.' From 1836 till 1845 he held the chair of chemistry applied to the arts in the Franklin Institute, delivering three courses of lectures extending over three years each. He was the author of an 'Encyclopædia of Chemistry' (Philadelphia, 1850) and with Campbell Morfit of a report 'On Recent Improvements in the Chemical Arts,' published by the Smithsonian Institution in 1852. His appointment to the mint was coincident with the discovery of gold in California, and the new processes required to prepare the bullion for coinage were largely of his own invention and many of them, to use his own words, 'were not known outside the mint.'*

It is well known that prior to 1850 and for some time thereafter Philadelphia was the acknowledged center for the manufacture of chemicals for medicinal use. To collect the details of the many improved methods for the production of these chemicals would be a long and difficult task, and would require more space than I have at my command in this article. The names of such firms as Powers, Weightman and Rosengarten and Sons are readily recognized as those of manufacturers of standard chemicals. M. I. Wilbert has recently published a paper, entitled 'Early Chemical Manufacturers: A Contribution to the History and Rise of the Development of Chemical Industries in America,' to which I must refer you for further information concerning their growth and progress.†

I am reminded in this connection that the name of Edward Robinson Squibb (1819–1900) is one well worthy of deserved recognition among manufacturers of chemicals. The ether prepared by him by processes of his own invention has long been accepted as standard. For a brief period during the early fifties of the last century Dr. Squibb was associated with J. Lawrence Smith (1818–83) in Louisville, Ky., in the commercial production of chemical reagents and of the rarer pharmaceutical preparations.* It is also proper to add the name of the Baker and Adamson Chemical Company of Easton, Pa., as that of a corporation which has established a reputation for the manufacture of pure chemicals by processes, many of which are of their own devising. The success of this young firm is generally admitted to be due to Edward Hart (1854–), who fills the chair of chemistry in Lafayette College.

Eben Norton Horsford (1818–93) made distinct contributions to technical chemistry and among these may be mentioned his invention of condensed milk. According to Charles L. Jackson, he originally prepared this most valuable article of food for use in Dr. Kane's Arctic expedition and afterwards presented the process to one of his assistants, who then sold it to Gail Borden. His name, however, is more commonly associated with his invention of a phosphatic yeast powder, the object of which is to return to the bread the phosphates lost in bolting the flour, and which, as is well known, form such an essential constituent of the food of animals. He also devised 'a marvelously compact and light marching ration of compressed beef and parched wheat grits,' which found some use at the time of the Civil War, and his name is also attached to the preparation

* A sketch of his career by Patterson Du Bois was presented before the American Philosophical Society on October 5, 1888, and has since been issued as a separate of eight pages.

† *Journal of the Franklin Institute*, CLVII., 1904, p. 365.

* See 'Original Researches in Mineralogy and Chemistry,' by J. Lawrence Smith (Louisville, Ky., 1884), p. xxxviii.

of 'acid phosphate,' so commonly used with summer beverages.*

The development of the mineral resources of our country has been due largely to those who from their knowledge of chemistry were able to recognize the commercial value of the natural deposits in the vicinity of their homes. This has been conspicuously the case with the great fertilizer industry of the south, and especially so in South Carolina, where the names of Charles Upham Shepard (1804–86) and St. Julien Ravenel (1819–82) are recognized as those of pioneers in that important branch of chemical industry.

To quote from Silliman again, and he is always an acceptable authority, "No observation or original research of Dr. Shepard has been fruitful of so much good in its consequences as his discovery of the deposits of phosphate of lime in the Eocene marl of South Carolina, and the distinct recognition of its great value for agriculture."† It was Dr. Ravenal, however, whose experiments made it possible to transform these phosphate rocks into commercial fertilizers, and of him the younger Shepard wrote in 1882: "Well might this community erect a public monument in honor of the man to whom preeminently is due the inauguration of that phosphate industry which has proven of such incalculable value to ourselves and others. As the statue of Berzelius adorns beautiful Stockholm, let us commemorate [similarly] the founder of Charleston's greatest industry." It may be added that Dr. Ravenel differed from the agricultural chemists of his time in devoting greater attention to the physiological phases of the application of fertilizers to plants than to the mere chemistry of the subject; this was naturally due to his early training in medicine. *

It would lead me too far from chemistry, perhaps, to discuss the work of the younger Shepard (1842–) in successfully introducing tea culture into the United States, but his farm in Summerville, S. C., is a monument to the application of his chemical knowledge to a new industry, and well may his fellow-countrymen be proud of the results.

It is desirable to mention at this place the remarkable successes achieved by a small band of chemists who spent the four years of our Civil War in their southland. George Washington Raines (1817–98), John Le Conte (1818–91), Joseph Le Conte (1823–91) and John William Mallett (1832–) are among the more conspicuous names that occur to me. It was Raines who erected at Augusta, Ga., the Confederate powder works, which at the close of the war were regarded 'as among the best in the world.'†

The Confederate government appointed John Le Conte to the superintendency of the extensive niter works established in Columbia, S. C., which place he retained during the war.‡ Joseph Le Conte, a younger brother, served as chemist to the Confederate laboratory for the manufacture of medicines in 1862–3, and also in a similar capacity to the niter and mining bureau in 1864–5. Professor Mallett was

* A sketch of his career prepared by Charles L. Jackson appeared in the *Proceedings of the American Academy of Arts and Sciences*, XXVIII., 1903, p. 34.

† *American Chemist*, V., 1874, p. 96.

* Two memorial pamphlets of Dr. Ravenel have been published. One, entitled 'In Memoriam, St. Julien Ravenel, M.D.' (9 pp.), is a reprint of an editorial from the Charleston *News and Courier* of March 18, 1882. The other, entitled 'Dr. St. Julien Ravenel,' is a memorial published by the Agricultural Society of South Carolina, Charleston, S. C. (54 pp.).

† He published in pamphlet form a 'History of the Confederate Powder Works' (Augusta, 1882).

‡ 'Biographical Memoirs,' National Academy of Sciences, III., p. 369.

in charge of the ordnance bureau of the Confederate states, serving with the rank of colonel. He has described his experience under the title 'Applied Chemistry in the South during the Civil War,'* which he has delivered as a lecture before various chemical societies.

A history of the manufacture of explosives in this country would carry us far into the past, for the oldest of the still existing powder mills was established in 1802 by Eleuthere Irene Du Pont and the name of Du Pont is still honorably associated with the industry, for so recently as 1893 two of that name received a patent for a smokeless powder which is now largely made at works near Wilmington, Del.

During the years 1862–4 Robert Ogden Doremus (1824–) developed the use of compressed granulated gunpowder, which was adopted by the French government. It was concerning this inventor that Sir Frederick A. Abel in 1890 in his retiring address before the British Association said that Doremus 'had proposed the employment in heavy guns of charges consisting of large pellets in prismatic form.' Charles Edward Munroe (1848–) must be recognized as the first in the world to prepare a 'smokeless powder that consisted of a single substance in a state of chemical purity.' This explosive, which he invented while chemist at the U. S. Torpedo Station, Rhode Island, and which became known as the 'naval smokeless powder,' was referred to by Secretary of War Tracy in 1892 as presenting 'results considerably in advance of those hitherto obtained in foreign countries.'†

Of later development is the Bernadou powder invented by John Baptiste Bernadou (1858–), of the U. S. Navy, and which it is claimed has been adopted for use in the naval branch of the service.

No contribution to the history of technical chemistry in the United States would be complete without some reference to the development of coal oil and petroleum. It seems almost impossible to realize that scarcely half a century ago the only use of petroleum was as a cure for rheumatism under the name of Seneca oil. The commercial exploitation of this important illuminant is, of course, largely due to the Standard Oil Company and to the expert chemists in their employ credit should be given for the production of the many beautiful by-products that are now made. A full description of these with proper reference to the chemist to whom we are indebted for them would, indeed, be valuable, but even for a simple enumeration of the products in tabular form giving their immediate origin I must refer you to the text-books on industrial chemistry.*

One of the most interesting of these many compounds is vaseline, whose use in pharmacy is so prevalent. It was invented in 1870 by Robert Augustus Chesborough (1837–). Charles Frederick Mabery (1850–) has been an indefatigable worker in the theoretical branch of the subject, especially on the composition of petroleum, in the study of which he has been aided with grants from the C. M. Warren Fund for Chemical Research of the American Academy of Arts and Sciences. Stephen Farnam Peckham (1839–) has been a prolific contributor to the literature of the technology of the subject,

* An abstract of this paper with the title 'Industrial Chemistry in the South during the Civil War' is contained in the *Scientific American* for July 25, 1903.

† The history of the 'Development of Smokeless Powders' was the subject of Dr. Munroe's presidential address before the Washington Section of the American Chemical Society in 1896. See *Journal of the American Chemical Society*, XVIII., 1896, p. 819.

* See 'A Handbook of Industrial Chemistry,' by Samuel P. Sadtler (Philadelphia, 1900), p. 21.

and his report on petroleum, prepared for the tenth census (Washington, 1880) is standard authority. Another chemist who has studied petroleum both in the laboratory and also from a commercial point of view as well, is Samuel Philip Sadtler (1847–). His 'Industrial Organic Chemistry' (Philadelphia, 1900) gives a very satisfactory survey of the subject with an admirable bibliography. Among the younger men I learn that William Cathcart Day (1857–) has succeeded by carrying out operations of distillation at the ordinary atmospheric pressure upon animal and vegetable matter, both separately and mixed, in obtaining three different materials, all of which present in different degrees the properties characteristic of asphalts.*

An early worker in the scientific part of this subject was Cyrus More Warren (1824–91), whose original researches on the volatile hydrocarbons and similar bodies resulted in many practical applications in the use of coal tar and asphalt, especially for roofing and paving purposes. Clifford Richardson (1856–) has in recent years devoted much attention to the study of asphalt and is a recognized authority on its value for commercial purposes.

I can not claim for the United States the invention of illuminating gas, although as early as 1823, its manufacture was begun in New York city, but the development of the production of a luminous water gas was largely accomplished in this country. According to excellent authority,† Thaddeus S. C. Lowe (1832–) built and successfully conducted gas works in Phœnixville, Pa., in 1874, producing a water gas 'far superior to that made from coal.' According to Dr. Chandler 'there are forty or fifty differing forms of apparatus for manufacturing [water gas], but they are almost without exception applications of the invention of Thaddeus Lowe.*

Those of us whose memories extend back for a quarter of a century may recall Tessie de Motay (1819–80), whose agreeable personality charmed all of those who were so fortunate as to meet him, and to him is due the production of water gas in the late seventies of the last century by a process of his own invention in New York city.†

A much-needed substitute for ivory and horn that could be produced economically was invented in 1869 by John Wesley Hyatt (1837–) and called by him celluloid. It is so seldom that foreign recognition is unqualifiedly given to our American inventors that I am glad of the opportunity to quote Thorpe,‡ who says, concerning celluloid, that it 'is an intimate mixture of pyroxlin (guncotton or collodion) with camphor, first made by Hyatt of Newark, U. S., and obtained by adding the pyroxlin to melted camphor * * * and evaporating to dryness.' Its many applications in various industries are so well known as to need no further mention here.

It should not be forgotten that saccharin, a coal tar compound with a sweetening

* *Journal of the Franklin Institute*, September, 1899, p. 205.

† See a 'Communication on the Lowe Gas Process,' New York (May, 1876) and 'A Communication on the Lowe and Strong Gas Processes' of later date (probably 1878) and also 'The Chemistry of Gas Lighting,' by C. F. Chandler (Philadelphia, 1876), a reprint from the *American Chemist* for January and February, 1876. There is also a pamphlet report on the 'History and Value of Water Gas Processes' (New York, 1864) by John Torrey and Carl Schultz which gives a brief summary of some sixty patents on the subject.

* *Journal of the Society of Chemical Industry*, XIX., 1900, p. 613, where also excellent descriptions of both the Lowe and the Motay processes are to be found.

† See sketch of Cyprien M. Tessie de Motay by A. J. Rossi in the *Journal of American Chemical Society*, II., 1880, p. 305.

‡ 'Dictionary of Applied Chemistry,' I., 1891, p. 449.

power of about five hundred times that of cane sugar, although now manufactured chiefly in Germany, was discovered in 1879 in the laboratory of the John Hopkins University by Constantin Fahlberg, a student under Ira Remsen (1846–) and the Society of Chemical Industry in 1904 crowned Remsen's work by conferring upon him the medal of the society, recognizing thus for the first time in its history the discoveries of an American chemist.

In the domain of technical chemistry no American has ever achieved greater results than Hamilton Young Castner (1858–99), and the opportunity of presenting a brief summary of his brilliant inventions is a pleasure that I gladly welcome.

His first invention was a continuous process for the manufacture of bone charcoal, but this failed of commercial success, although scientifically of much interest, and he then turned his attention to the study of an improved method for the production of aluminum. To accomplish this it was necessary to produce sodium economically, and this he succeeded in doing by using carbide of iron as a reducing agent. When he began this now historic research the market price of aluminum was $10 a pound, and when his process was completed he was able to manufacture aluminum at about one dollar a pound. "This," says Dr. Chandler, "revolutionized the whole industry and aluminum could be now used for a hundred different purposes." In his retiring address before the British Association in 1890 Sir Frederick A. Abel said: "The success which has culminated in the admirable Castner process constitutes one of the most interesting of recent illustrations of the progress made in technical chemistry."

But there were other uses for which sodium could be employed, and so he invented a process for converting metallic sodium into sodium peroxide. Then came the suggestion that with cheap sodium pure cyanides could be produced, and so he modified his process so as to manufacture pure cyanides, especially the potassium and sodium cyanides, enormous quantities of which were used for the extraction of gold from low-grade ores. His active mind was ever busy with new solutions of chemical problems, and subsequent to the invention of electrolytic processes for the reduction of aluminum, Castner concentrated his attention on the original methods used by Sir Humphry Davy and overcoming the difficulties encountered by that great chemist he soon devised an electric process of remarkable simplicity for obtaining metallic sodium from caustic soda by electrolysis. His ambition was not yet satisfied and he added to his triumphs a beautiful method for the electrolysis of common salt with the production of caustic soda and bleaching powder. Thus Castner invented 'the first process which could be said to be a complete success; for accomplishing what French, German, English and American chemists had been working at for a hundred years.' Again to quote Chandler:* 'He never worked on a chemical process that he did not invent a better one to accomplish the same result.'

The silver metal and the white crystals, pure and beautiful, the results of his many hours of study and research, will always preserve in the literature of chemistry the memory of him of whom it is surely not too much to say that he was the most eminent of American inventors in chemical technology in recent times.

While Castner was studying the problem of preparing aluminum by chemical methods Charles Martin Hall (1863–),

* See the 'Unveiling of a Bronze Tablet in Havemeyer Hall to the Memory of Hamilton Young Castner, December 16, 1902,' *School of Mines Quarterly*, XXV., January, 1904, p. 204.

a student in Oberlin College, conceived the plan of extracting aluminum by electrolysis and he found that a melted bath of the double fluorides of aluminum and metals more electro-positive than aluminum, such as sodium or calcium, was a perfect solvent for alumina, and from such a solution he was able to separate the aluminum by means of the electric current. It is by this process that all of the aluminum of commerce is produced to-day.

Moissan, whose extended researches with the electric furnace have made his name justly famous, writes: 'The discovery of crystalline carbon silicide belongs to Acheson.'* This remarkable abrasive, prepared by heating a mixture of silica, coke, alumina and sodium chloride in an electric furnace, was invented in 1890 by Edward Goodrich Acheson (1856–) while experimenting for the artificial production of diamonds, and is one of the many beautiful products obtained at Niagara Falls, where quite a number of chemical manufacturers have established their plants in order to take advantage of the power obtained from the great waterfall. Mr. Acheson has also succeeded in preparing artificial graphite as a by-product in the manufacture of the carborundum, and he claims that it is the result of the decomposition of the carbide formed in that process.†

Although the existence of calcium carbide has been recognized ever since its original production in 1857 by Edmund Davy, Wöhler and Berthelot, it was not until May, 1892, that its commercial production became known in consequence of its chance discovery by Thomas Leopold Willson (1860–) while experimenting in Spray, N. C. He obtained it by the fusion and reduction in an electric furnace of a mixture of finely powdered and intimately mixed lime and coke. When it comes in contact with water decomposition ensues with the production of acetylene gas, an illuminant of remarkable power. This valuable compound is also manufactured at Niagara Falls.

Another valuable application of the high temperatures obtained by the electric furnace to substances from which the extraction of the metal was formerly considered impossible is the method patented in November, 1903, by Frank Jerome Tone (1868–), of Niagara Falls, N. Y., for obtaining metallic silicon by reducing silica with carbon in an electric furnace of his own construction.

Of great value is the elaborate bulletin* on 'Chemicals and Allied Products' prepared for the twelfth census by Charles Edward Munroe, already mentioned, and Thomas Mareau Chatard (1848–). The industries discussed are grouped into nineteen classes and with each the discussion is introduced by a history of the development of the manufacture in the United States, and at the close is a brief bibliography. The volume includes a digest of United States patents relating to the chemical industries.

Worthy of the most distinguished consideration is the career of Charles Frederick Chandler (1836–). This eminent chemist has since 1864 taught the technical chemistry in the Schools of Science in Columbia University and no record of the development of chemistry applied to the arts in the United States would be complete without mention of his work. It is true that no great invention bears his name, but he has achieved results greater than inventions, for he has educated chemists, and yet even more than that as we shall see. Go where you will and you will find busy workers in science who have learned from

* 'The Electric Furnace' (Easton, 1904), p. 273.

† *Journal of the Society of Chemical Industry*, XIX., 1900, p. 609.

* Census Bulletin, No. 210. Quarto, 306 pp. Washington, June 25, 1902.

Chandler something of that splendid power of applying chemical methods to the subject at hand which has long since gained for him the reputation of being the foremost authority on technical chemistry in the United States. Wherever gold or silver is determined, the little assay ton weights—their conception was a stroke of genius—claim him as their inventor. The brilliant series of articles on technical chemistry—the best in the English language—that appeared in Johnson's Cyclopedia were written by him. The first museum of applied chemistry in the United States where the crude material may be studied in its course of development to a finished product was established by him. Masterly, indeed, are the practical contributions to chemistry which marked the years during which he had charge of the public health in New York city. It resulted in enormous benefits to the community, and in 1883 it was well said: 'There is no other city in the world which has so complete a sanitary organization as New York'; for all of which credit is due to Chandler.* In 1889 he was chosen president of the Society of Chemical Industry, the first American upon whom that honor was conferred, and a year later, on June 18, 1900, in the lecture theatre of the Royal Institution founded by Count Rumford, to whom reference has already been made, he delivered his presidential address on 'Chemistry in America,' in the course of which he elaborated most fully the achievements of those who have distinguished themselves in that branch of science in the United States.†

* See the sketch of Charles Frederick Chandler by the present writer in the *Scientific American*, LVII., July 16, 1887, p. 39, and 'President Chandler and the New York City Health Department, 1866–1883,' in the *Sanitary Engineer*, May 17, 1883.

† *Journal of Society of Chemical Industry*, XIX., 1900, p. 591.

It is worth while, I think, to mention very briefly three branches of our national government that have had much to do with the development of chemical technology in this country. The first of these and also the oldest, for it celebrated its centenary in 1891, is the patent office,* where inventors receive the protection of the government for their discoveries. By thus recognizing worthy inventions a valuable stimulus is given to invention which has not been without value to the community. Of exceptional interest to chemists is the system of indexing chemical literature now in use in the classification division of the patent office.†

I will also call your attention to the excellent work done in the Division of Mineral Resources in the U. S. Geological Survey, where under the efficient direction of David Talbot Day (1859–) valuable information and statistics are gathered concerning native minerals and ores from which are obtained the products of so many of the leading chemical processes.‡

Finally the bureau of chemistry of the Department of Agriculture has been a potent factor in the development of chemical industries. It was this bureau that first called the attention of the public to the possibility of establishing the beet sugar industry in the United States. As a result of the investigations carried on by chemists in this branch of the government service the average yield of cane sugar to

* 'Patent Centennial Celebration, 1891: Proceedings and Addresses,' 554 pp. (Washington, 1892).

† See 'On a System of Indexing Chemical Literature; Adopted by the Classification Division of the United States Patent Office,' by E. C. Hill, *Journal of the American Chemical Society*, XXII., 1900, pp. 478–498; also *Scientific American*, LXXXVI., June 14, 1902, p. 411.

‡ Beginning with the year 1882, annual volumes of the Mineral Resources of the United States have been published.

the ton in the state of Louisiana has been increased from 130 pounds to 170 pounds. In the examination of road materials important contributions to technical chemistry have been made by this bureau. The valuable studies on the dietetic value of foods and on their adulterations, conducted under the direction of Dr. Harvey Washington Wiley (1847–) have not only done much towards creating a demand for the enactment of national legislation for pure food, but they have also been praiseworthy contributions to the application of chemistry to sanitation. This bureau also should receive recognition for its fostering influence over the Association of Official Agricultural Chemists, an organization which has done so much to secure uniform methods of analysis of fertilizers and of foods.*

To Henry Carrington Bolton (1843–1903) is due the credit for the series of bibliographies of the literature of the chemical elements that have been published by the Smithsonian Institution. His own memory will always be worthily preserved by the splendid 'Bibliography of Chemistry' in four octavo volumes, an important section of each of which is devoted to technical chemistry.

The records of the past give abundant hope for the future.

Marcus Benjamin.
U. S. National Museum.

THE PHYSIOLOGICAL SECTION OF THE CENTRAL BRANCH OF THE AMERICAN SOCIETY OF NATURALISTS.

A physiological section of the Central Branch of the American Society of Naturalists was organized and held enthusiastic meetings on March 31 and April 1 during the recent meeting at Chicago. The sectional meeting was called to order in the Hull Physiological Laboratory and Professor G. N. Stewart was chosen chairman.

The following papers were presented:

Changes in the Percentage of Water in the Central Nervous System of the White Rat between Birth and Maturity: H. H. Donaldson.

Between birth and one year of age the percentage of water in the brain of the white rat falls from approximately 89 per cent. to 77 per cent., and in the spinal cord from 86 per cent. to 69 per cent.

In the brain the rapid decrease occurs during the first seventy days of life, while in the cord this period is somewhat more prolonged.

Taking the converse change of increase in solids, it is found that in both the brain and the cord the solids increase more rapidly than does the weight of the organ, a relation probably dependent on the process of medullation.

In general, the percentage of water in the central nervous system is very closely correlated with the age of the animal, and almost independent of its absolute body weight.

On the Presence of a Sulphur Compound in Nerve Tissues: Waldemar Koch.

Kossel first called attention to the fact, later confirmed by Cramer, that all preparations of protagon contained sulphur. Thudichum isolated an impure barium salt containing four per cent. of sulphur, which he classed as a cerebrosulphatid.

A comparison of the organically combined sulphur (not proteid sulphur) present in various tissues gives the following result expressed in parts per million: Spinal cord, 1,029; liver, 470; striated muscle, 310; testicle, 209; submaxillary gland, 135. These figures point very

* The literature issued by the Bureau of Chemistry is large and includes nearly one hundred important bulletins and many minor circulars and leaflets.

strongly to a sulphur metabolism in the nervous system, as even the liver, which is supposed to play such an important rôle in sulphur metabolism, contains only half as much as the spinal cord. Results indicate that the sulphur compound or compounds exist in the nervous system partly combined and partly free; in the liver they are not combined. Attempts to isolate and purify for analysis a compound containing sulphur have so far been only partially successful on account of the extremely poor yields. A barium salt was obtained, resembling Thudichum's compound, but containing more nitrogen. With regard to solubility and chemical reactions the compound agrees best with Cloetta's uroproteic acid. My barium salt contains, however, twice as much sulphur as Cloetta found, and, besides, a very considerable amount of phosphorus, which either represents an impurity in every case or was present in Cloetta compound also, but not detected by him. My compound calculated as the free acid gives approximately the following formula, $C_{60}H_{120}N_{12}S_2PO_{40}$, as compared with Cloetta's $C_{66}H_{116}N_{20}SO_{54}+ nH_2O$. The investigation will be continued as soon as more material is available.

The Excretion of Nitrogen by the White Rat According to Weight and Age: SHINKISHI HATAI.

A cage for collecting urine and feces separately was especially constructed for the present work. The animals were kept for three days in the cage and were fed exclusively with Uneeda biscuit and water. From the observations on 89 rats, which ranged from 32 grams up to 382 grams, the following results were obtained:

1. The total amount of urine increases with the body weight up to 120 grams, then decreases very decidedly. From 180 grams it again ascends up to 220 grams, where it remains rather constant.

2. The total amount of nitrogen is quite independent of the amount of urine. It increases constantly and continuously as the animals grow in weight. When the total amount of nitrogen is plotted on base line according to the body weight the curve thus obtained presents an approximately straight line. On the other hand, the curve on base line according to age presents a distinct period of rapid rise up to somewhere between 200 grams to 240 grams.

3. About 91 per cent. of the total nitrogen in the case of the young and 89 per cent. in the larger represent the urinary nitrogen.

4. The total amount of nitrogen eliminated by rats of different weights during 24 hours can be determined with a high degree of accuracy by the formula

$$\log N = \frac{233 + \log \text{B. W.} \times 3}{4}$$

where N = total nitrogen in milligrams and B. W. = body weight in grams.

Further Evidence of the Fluidity of the Conducting Substance in Nerves: A. J. CARLSON.

The pedal nerves of gasteropods (*Ariolimax*) and the ventral nerve-cord of worms (*Bispira*) have relatively great elasticity and may be stretched to nearly twice their shortest length without impairing their function or altering their condition sufficiently to cause stimulation. This stretching does not affect the intensity of the impulse conducted through the nerves, as shown by the muscular response. But the time required for the impulse to travel through the nerve increases in proportion to the degree of stretching of the nerve in such way that delay in time is directly compensated by the additional length of the nerve in the stretched condition, so that the actual rate of propagation of the nervous impulse remains the same in the

stretched and the relaxed nerve or nerve-cord. The increase in the transmission-time shows that the stretching is not merely a straightening out of kinks or folds in the nerve-fibers. The conducting substance must be actually extended. But this extension of the conducting substance is effected without inducing any changes of stress or tension in it, because the process (nervous impulse) conducted by it is not altered. Such an extension of conducting substance can be effected only in case it is in a fluid condition.

The Antagonistic Action of Calcium to Barium, and of Calcium and Barium to Veratrin, on the Mammalian Heart: S. A. Matthews.

Calcium salts and barium salts show the same antagonism as regards the mammalian heart as Sydney Ringer observed on the heart of the frog. Further, both calcium and barium are antagonistic to veratrin. Barium shows a greater antagonism to veratrin than calcium, but owing to the marked poisonous properties of barium in sufficient doses to counteract the veratrin effects, calcium is necessary to check in part the barium effects, and the antagonism to veratrin is more complete if a solution of $m/2{,}000$ $BaCl_2$ made up in an $m/8$ $CaCl_2$ solution be injected. This also corroborates Ringer's results on the frog's heart.

Determination of Freezing Point of Small Quantities of Liquid, Especially for Clinical Purposes: T. M. Wilson.

Dr. G. N. Stewart suggested that it would be worth while to investigate whether by using a small tube and adding to a small quantity of a solution whose freezing point was to be determined a quantity of a liquid which does not exert osmotic pressure (clean mercury, *e. g.*) sufficiently large to insure complete immersion of the thermometer bulb, fairly satisfactory readings might not be obtained. By performing all the manipulations in a definite way, and, in particular, keeping the degree of undercooling about the same in successive observations, it was found that this was the case. Comparison of the results obtained on a standard salt solution by this method and by the ordinary method showed that readings reliable to the hundredth of a degree centigrade could be got with as little as 0.3 c.c. of solution. The determinations are, of course, less accurate than those made with 10 or 15 c.c., but the method will, it is hoped, permit the approximate measurement of the freezing point of such quantities of blood or serum or of the rarer animal liquids as are easily available for clinical purposes, without diluting with water or salt solution, a procedure to which there are weighty objections.

Preliminary Report on an Attempt to Determine the Oxidizing Coefficients of Different Tissues: H. McGuigan.

The tissues of the body are known to differ in their oxidizing powers. The attempt was made to express the comparative oxidizing powers of the more common sugars in terms of electro-chemical units, with the hope of getting data from which to compute the voltage necessary to relieve the enzymes of their charges and thus indirectly obtain their oxidizing powers (see A. P. Mathews, *Am. Jour. Physiol.*, Vol. X., p. 450). Comparative figures were obtained for lactose, maltose, glucose, galactose and levulose.

Neutral copper acetate will oxidize all of the above sugars in the order given, lactose being the most difficult. The addition of known quantities of acetic acid will prevent the oxidation. The volume of the acid sufficient to do this differs for each of the sugars, increasing from lactose to levu-

lose in the order given above. The constants were taken from the formula:

$$\frac{\text{Cu acetate} \cdot \cdot v\frac{100}{a}}{v.\ \text{acetic acid} \cdot \frac{100}{\beta}} = K$$

where v is the dilution, a the percentage of copper hydrate at 100° C., and β the percentage of ionized acetic acid. The following values of K were obtained:

Levulose	0.0276
Galactose	0.0185
Glucose	0.0176
Maltose	0.0096
Lactose	0.0078

If we determine K for Barfoed's reagent in the same way, considering that in the use of it we would dilute it about one half, we get 0.0130. This places it between the mono- and disaccharides, where it should be theoretically.

Artificial Production of Heart Rhythm: DAVID J. LINGLE.

Physiologists believe rhythmic activity can be revived in heart muscle by electrical, mechanical and chemical agencies. These ideas are based on work done by experimenters who ignored the rôle of salt solutions in producing rhythms and used a sodium chloride solution to hold or moisten a heart strip when testing the power of an agent to make it beat. As a sodium chloride solution of itself has this power, a result obtained under these conditions is unsatisfactory because the agent tested has been made to act with another capable of producing the result.

The inference, from work of this kind, that a constant current is a rhythm producer, is not correct. Because when the same constant current is made to pass through two similar strips from the same heart, one in a moist chamber, the other in air, a rhythm appears only in the latter, which is moistened with NaCl solution, to prevent drying. The other strip with the same current, but without the NaCl solution, remains quiet. (In this experiment the non-polarizable electrodes should be moistened with LiCl solution, otherwise they may hold enough NaCl to start a rhythm.)

The same is true of strips treated with induction shocks, either slowly repeated or tetanizing. With a NaCl solution they start rhythms, but without it they do not. Mechanical tension, either constant or intermittent, will cause rhythms if the suspended strips are moistened with a NaCl solution, but it fails without this. It would seem, then, that the rhythm-producing power of electrical and mechanical agents of this kind is due entirely to the NaCl solution used along with them.

No work along this line has been done to test the powers of the various chemical agents. But as most of these have been used with a solution of NaCl, it will be found, in all probability, that they are not exceptions. Most of them are simply compounds that do not interfere with the action of the NaCl used with them, rather than real rhythm producers.

Experiments on Resuscitation: C. C. GUTHRIE and G. N. STEWART.

Kuliabko's work on resuscitation of the excised mammalian heart after a long interval led us to undertake resuscitation experiments in entire animals. These were begun in the autumn of 1902.

After five to fifteen minutes' complete stoppage of the heart (determined by inspection) by asphyxia, drowning, ether, chloroform or electrical currents, in many cases an efficient circulation was reestablished. A combination of artificial respiration, heart massage, occlusion of the aorta and arterial injection of defibrinated blood gave the best results.

Disappearance of the pulse as deter-

mined by palpation or by the manometer curve does not coincide with complete stoppage of the heart. We saw restoration up to forty-four minutes after the pulse ceased to be felt. Doubtless the period of complete stoppage was shorter.

Before proceeding further it seemed advisable to determine the limit after which resuscitation is possible in particular organs and tissues, especially in the brain and cord. In cats the chest was opened and the innominate and left subclavian arteries, and the aorta immediately below the origin of the left subclavian, were clamped. Artificial respiration was maintained. The heart continued beating well for a considerable time. The reflexes disappeared usually in ten to thirty-five seconds, the respiration about the same time, a few gasps following for a minute or two more. The innominate and left subclavian were released after varying intervals, the aorta remaining clamped. The functions of the anterior part of the animal (including the brain and cervical cord) returned after an interval which was longer the greater the period of occlusion, but dependent also on the efficiency of the circulation. The longest interval after which complete restoration (including voluntary movements, eye reflexes, etc.) has been hitherto obtained is twenty-five and a half minutes. After a fifty minutes' occlusion* excellent respiratory movements returned, together with strong reflex movements of the fore limbs, including good crossed reflexes, jaw reflexes and violent general spasms of the whole anterior part of the animal. The eye reflexes were not restored nor were we certain that any voluntary movements returned.

The symptoms appear in a fairly definite order: (1) some constriction of the pupil; (2) twitching of skin over shoulders, on lower jaw or head or in the tongue; (3) gasping movements of jaws rapidly increasing in intensity and rate, and soon involving neck, shoulders, chest and fore limbs; (4) eyelid, light, and fore limb reflexes, the latter first confined to the limb struck, but later crossed. The reflex excitability of the anterior portion of the cord is abnormally great; (5) extensor spasms of fore limbs, neck and head (usually opisthotonus); (6) voluntary movements of head, eyes and limbs.

We do not know whether animals after such a long period permanently survive. A cat in which all symptoms of complete anemia of the anterior part of the body were present for five minutes after occluding the innominate and left subclavian arteries, artificial respiration being kept up through a tube inserted through the glottis, recovered completely, although the extensor spasms after the anesthesia had passed off were marked. Another cat after ten minutes' complete anemia had severe spasms and croupy respiration for some hours. The spasms and dyspnœa do not depend on any lack of oxygen in the blood, shown by the appearance of the gums, tongue, etc., and they are not relieved by oxygen inhalation. This animal rapidly recovered, showing only some paralysis of the right limbs, which gradually improved.

Some preliminary experiments have been made on the maintenance of an artificial circulation through the isolated head with the view, among other points, of ultimately investigating the question of cerebral vasomotors. In one case the eye reflexes were still obtained with artificial circulation of defibrinated blood after about nine minutes. As the blood had been kept in the ice box for twenty-four hours after being used for a previous experiment, and as this was one of our earlier experiments, there is no doubt that a much better result can

* This experiment was performed after the presentation of our paper.

be got. Defibrinated blood was found to be better than Locke's solution.

The Nature of Cardiac Inhibition, with Special Reference to the Heart of Limulus: A. J. CARLSON.

It is commonly believed to-day that the cardio-inhibitory nerve-fibers act directly on the heart muscle. This view is a corollary of the myogenic theory of the nature of the heart-beat. In *Limulus* the heart beat is neurogenic. The cardio-inhibitory nerves act on the local heart ganglion in a way to stop or diminish its activity and do not act directly on the heart muscle. This conclusion rests on the following evidence: (1) stimulation of the nerves that pass from the cardiac ganglion to the heart muscle produces motor and not inhibitory effects; (2) the diminution of the excitability of the heart during complete inhibition is the same as after extirpation of the heart ganglion; total inhibition thus amounts to throwing the ganglion out of function; (3) atropin paralyzes the cardio-inhibitory nerves only in case it comes in contact with the heart ganglion, but not if it comes in contact with the heart muscle and the nerves passing from the ganglion to the heart muscle.

Weber's theory of the nature of the cardiac inhibition is thus shown to be true for the *Limulus* heart. Stimulation of cardio-inhibitory nerves in *Limulus* produces the same effects as those produced in the vertebrate heart by stimulation of the vagi. The mechanism of cardiac inhibition in vertebrates probably does not differ from that in *Limulus,* as all the changes produced in the heart by the stimulation of the vagi can be accounted for on Weber's theory. Cardiac inhibition is, therefore, to be referred to the category of inhibitory processes known to take place in the central nervous system, that is, the inhibition of one neural process by another.

Effects of Simultaneous Section of Both Vagi above the Origin of the Recurrent Laryngeal: G. N. STEWART.

1. At the Madrid International Congress of Medicine (April, 1903) Ocaña showed a dog which, ten weeks after this operation, was in perfect health. It remained so for more than six months. He supposes that this was the first instance of such a result. In November, 1900,* however I described similar cases. In February, 1897, a dog was operated on, which lived in excellent health for many months. An account of this animal was sent on March 31, 1897, to a friend for insertion in an eastern medical journal, but was not considered suitable. At the autopsy I found the two portions of the left vagus still separated by a wide interval. In the right vagus such perfect union had taken place that only a fine linear scar remained, barely visible to the eye, but easily recognizable with the aid of a hand lens, and still better on microscopical examination of longitudinal sections. Such instances of perfect recovery and long survival are quite rare, at least in this climate (two, or at most three, cases out of sixty dogs, in my experience). Whether they are to be explained by some anomaly in the distribution of vagus fibers, or by some happy 'conjunction of circumstances,' which enables the animal to survive the critical period, or, what seems less likely, by an abnormally rapid regeneration or partial regeneration of one of the nerves, must be left undecided.

2. In all dogs (including these exceptional cases) after double vagotomy the ratio, pulse rate to respiratory rate is much increased (before operation, 3:1 to 5:1; after operation, 9:1 to 40:1). If the animals live for more than a few days the ratio tends to diminish somewhat through slowing of the pulse. The rate of respiration,

* 'American Yearbook of Medicine,' 1901, p. 548.

except in the anomalous animals that survive indefinitely, shows remarkable constancy even in dogs which live several weeks. Thus, after double vagotomy, a regulation of the heart rate is again developed which tends to bring it back towards the normal, while in the case of the respiration, such a tendency, if it exists, is much feebler. In the exceptional animals the ratio shows a marked tendency, even in the first few days, to return towards normal, both by a diminution in the pulse rate and by an increase in the rate of respiration.

3. After section of the whole of one vagus and about half of the other, the remaining vagus fibers are sufficient to keep the rate of the heart and respiration almost normal. With how small a proportion of vagus fibers intact, dogs (apart from the anomalous cases mentioned) will survive, remains to be determined, although it has been found that artificial stimulation of a comparatively small number of fibers causes the usual effects on the heart and respiration.

The Influence of the Blood Pressure and of Atropin and Nicotin on Experimental Glycosuria: J. J. R. MacLeod and D. H. Dolley. (Preliminary communication.)

The glycosuria which follows puncture of the floor of the fourth ventricle in rabbits can be inhibited by the administration of nicotine. This may act either by paralyzing the synapses of the centrifugal fibers from the so-called glycosuric center as they pass through the upper thoracic sympathetic ganglia, or be due to a fall in blood pressure.

By applying nicotin directly to these ganglia the glycosuria produced by stimulation of the central end of the vagus is also inhibited, but the marked fall in blood pressure which follows the operation necessary for exposing the ganglia, and not the effect of the drug on the synapses, may be the cause of the inhibition.

In dogs a fall of blood pressure to 40 mm.—produced by hemorrhage—causes the glycosuria produced by stimulation of the central ends of the vagi to disappear.

The injection of nicotin into dogs or rabbits rendered glycosuric by vagal or depressor stimulation does not, as a rule, have any influence in the amount of sugar in the urine.

Atropin has no constant effect either on puncture glycosuria or on that due to stimulation of the vagus or cardiac depressor. Sometimes it causes the amount of sugar in the urine to diminish markedly, at other times it has no effect. No explanation can be offered for this result.

Chas. W. Greene,
Secretary.

SCIENTIFIC BOOKS.

The Phase Rule and Its Applications. By Alex. Findlay. With an Introduction to the Study of Physical Chemistry by William Ramsay. 13 x 18 cm.; pp. lxiv + 313. New York, Longmans, Green and Co. 1904. Price, $1.60.

While physical chemistry in a certain sense is as old as physics or chemistry, the appearance of Ostwald's 'Lehrbuch der allgemeinen Chemie' some twenty years ago really marks the beginning of a new era. Since that time physical chemistry has developed along two quite distinct lines. Van't Hoff brought forward the osmotic pressure theory of solution and Arrhenius the theory of electrolytic dissociation, the two resulting in what may be called the quantitative theory of dilute solutions. Most chemists are fairly familiar with the development of this theory. Not so many people have interested themselves in the second line of work. Roozeboom felt the need of a basis of classification for the numerous double salts and compounds which are met with in inorganic chemistry. He found this in the phase rule of J. Willard Gibbs and he has developed it until it is now seen to be the one

possible general basis of classification for all chemical phenomena. Its results are purely qualitative, but they are absolute.

There has been a feeling that there was something antagonistic between the qualitative classification of equilibria and the quantitative study of equilibria. When put in this way, the feeling is seen to be absurd, since the two things supplement each other. It is only by combining the two that we can hope to attain to a quantitative theory of all chemical phenomena.

Mr. Findlay gives a very clear and elementary statement of the phase rule and its applications. The book can be recommended most heartily. There are a few mistakes here and there, but they are not of serious importance. We have here a most satisfactory introduction to the phase rule. It should not be forgotten that the phase rule is valuable in two ways, as a basis of classification and as an instrument of research. It is only the first aspect which has been considered in this volume. This is quite right and proper; but it is as an instrument of research that the phase rule is to come more and more prominently to the front in the next decade. The time has not yet come when a book can be written on this; but such a book will be necessary before very long, and it is to be hoped that Mr. Findlay may see his way clear to writing it.

WILDER D. BANCROFT.

CZAPEK'S BIOCHEMIE DER PFLANZEN, VOL. I.

ONE of the most unsatisfactory chapters on the subject of plant physiology is that relating to the chemical nature of plant substances and the reactions involved in their production and utilization. This situation has been due, not only to the intrinsic difficulties of the problems involved, but also to the unsatisfactory condition of the literature on the subject. While the handbook of Pfeffer has given the latitude and longitude of these problems to the student undertaking a serious study of the chemical aspect of plant physiology, the more detailed account of this phase of the science prepared by Czapek will be a most highly appreciated resource.

The first volume of the work under discussion reveals the scope of the undertaking. The preface indicates that the author has not proposed to write a text-book introducing the beginner to the subject, but rather to prepare a reference work which shall aid the more advanced investigator to use conveniently the work of his predecessors. This object has been most successfully accomplished, and no student of plant physiology can afford to miss this book from his list of immediately available helps.

Czapek's services have not been enumerated, however, when the results of his wide reading and patient summarizing have been recognized, since the work in question is vastly more than a mere compilation. In these days when the democratic spirit of science opens the door of public expression to men of all ranks of scholarship, the task of discriminating accurately the raw from the ripe and the hasty from the well wrought is not always readily accomplished, and a proper sorting of the material at hand by one so well qualified is a genuine service to science.

Then, again, in this eager time when so many men are straining to get the first glimpse of the real solution of fundamental problems, some are bound to guess shrewdly while others are endeavoring to be sure before speaking. To wisely divide this shrewd guess work from the solid fabric is the work of no mere compiler. In this direction, Czapek has rendered good service.

The general chapters introducing the book are all worthy, but of the various subjects treated an especial interest at present attaches to the discussion of the fundamental facts of enzyme action, of the bearing of the theory of ionization on physiological processes and the significance of colloids and the colloidal condition. These subjects are here treated in an illuminating way.

The special part discusses in detail fats, lecithins, physosterin and related compounds, carbohydrates and the bodies forming the cell membranes. On the subjects covered by this volume, the student is given a practically complete citation of the literature appearing prior to June, 1904.

The second volume, the printing of which has been begun, will appear in the near future and conclude this most important contribution of the working student of vegetable physiology. RODNEY H. TRUE.

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for May brings this journal up to date. It contains articles on the 'Affinities of the Genus *Equisetum*,' by D. H. Campbell; 'Movements of Diatoms and Other Microscopic Plants,' by D. D. Jackson, and, after a long interval, another of the valuable 'Synopses of North American Invertebrates, XX., Families and Genera of Araneida,' by Nathan Banks; 'Biology of *Acmæa testudinalis* Miller,' M. A. Willcox; 'Habits of the West Indian Whitebait,' A. H. Clark, and notes and reviews.

THE May number (volume 11, number 8) of the *Bulletin of the American Mathematical Society* contains: Report of the February meeting of the San Francisco Section, by G. A. Miller; 'On the development of mathematical analysis and its relation to certain other sciences,' by Emile Picard (St. Louis address), translated by M. W. Haskell; 'On the class of the substitutions of various linear groups,' by L. E. Dickson; 'Note on a problem in mechanics,' by A. M. Hiltebeitel; 'A geometric construction for quaternion products,' by Irving Stringham; Reviews of Lechalas's Géometrie générale, by Oswald Veblen; Netto's Elementare Algebra, by J. H. Tanner; Murray's Infinitesimal analysis, by W. B. Fite; Tanner's Elementary algebra, by James Pierpont; Annuaire du Bureau des Longitudes, by E. W. Brown; Gibbs-Roy's Diagrammes et surfaces thermodynamiques, by W. F. Durand; 'Notes'; and 'New Publications.'

SOCIETIES AND ACADEMIES.

THE MICHIGAN ACADEMY OF SCIENCE.

THE annual meeting of the Michigan Academy of Science took place at Ann Arbor, March 30, 31 and April 1. The programs of papers were good, and the meetings well attended by members and others from all parts of the state. On the evening of March 30 the annual address was delivered in University Hall before an audience of two thousand by Professor T. C. Chamberlin, of the University of Chicago, the topic being 'Old and New Hypotheses of the Earth's Origin.' The evening of the thirtieth was spent in a social smoker tendered by the University Research Club; and the excellent address of the retiring president of the academy, Dr. A. C. Lane, state geologist of Michigan, was delivered the afternoon of April 1, the topic being 'Natural Resources, their Conservation and Compensation for Necessary Consumption, one Feature of which is a Scientific Search for Substitutes.'

The academy has had introduced into the state legislature a bill for a topographic survey, and another bill for a natural history survey. The prospect for the passage of these bills seems good, and the academy decided to engage in a vigorous campaign to effect that end.

Papers were read as shown by the following programs:

SECTION OF AGRICULTURE.

Vice-President, W. J. Beal, Agricultural College.

KENYON L. BUTTERFIELD, president of State Agricultural College, Rhode Island: 'Outline of a Course in Rural Sociology.'

W. O. HEDRICK, Agricultural College: 'Syllabus for an Elementary Course in Economics.'

R. S. SHAW, Agricultural College: 'Syllabus for a Four-year Course in Live-stock Husbandry.'

U. P. HEDRICK, Agricultural College: 'Syllabus for a Four-year Course in Horticulture.'

J. L. SNYDER, president of Agricultural College: 'Social Phases of Agricultural Education.'

U. P. HEDRICK, Agricultural College: 'Outline of Topics in Horticulture for some Grades of Common Schools.'

CLARENCE E. HOLMES, superintendent of State School for Blind, Lansing: 'The Place of Agriculture in the Rural Schools.'

F. L. KEELER, Mt. Pleasant: 'School Gardens.'

J. B. DANDENO, Agricultural College: 'Some Experience in the Management of School Gardens.'

ERNEST BURNHAM, Kalamazoo: 'The Preparation of Teachers for the Rural Common Schools.'

C. W. GARFIELD, Grand Rapids: 'The Rural School Museum.'

L. H. BAILEY, dean of Agricultural School, Cornell University: 'Planning Courses for Rural Schools.'

JOSEPH A. JEFFERY, Agricultural College: 'Some Lessons Concerning Soils for the Common Schools.'

SECTION OF BOTANY.

Vice-President, J. B. Dandeno, Agricultural College.

F. C. NEWCOMBE, Ann Arbor: 'Geotropic Response of Stems and Roots at Various Angles of Inclination.'

J. B. DANDENO, Agricultural College: 'Color Stimuli and Plant Functions.'

J. B. POLLOCK, Ann Arbor: 'A Canker of the Yellow Birch accompanied by Nectria.'

F. A. LOEW, Agricultural College: 'A Study of the Effect of Dilute Solutions of Hydrochloric Acid upon the Radicles of Corn Seedlings.'

ELLEN B. BACH, Agricultural College: 'The Toxic Action of Copper Sulphate upon Certain Algæ, in the Presence of Foreign Substances.'

WALTER G. SACKETT, Agricultural College: 'The Relation of Bacteria to Plant Food.'

J. B. POLLOCK and C. H. KAUFFMAN, Ann Arbor: 'Michigan Fungi Not Previously Listed in the Reports of the Michigan Academy of Science.'

R. P. HIBBARD, Ann Arbor: 'Sexual Reproduction in a Red Alga (*Calithamnion Baileyi*).'

W. J. BEAL, Agricultural College: 'Vitality of Seeds after Twenty-five Years.'

J. B. POLLOCK, Ann Arbor: '*Polystictus hirsutus* as a Parasite on Mountain Ash, Maple and Carpinus.'

J. B. POLLOCK, Ann Arbor: 'Note on *Ganoderma* (*Fomes*) *sessile*, Murrill, Its Variation from the Original Description and Possible Parasitism.'

S. O. MAST, Holland: 'A Device for Aerating Aquaria.'

E. N. TRANSEAU, Alma: 'Climatic Centers and Centers of Plant Distribution.'

FRANCES STEARNS, Adrian: 'A Study of Plants in Ravines near Adrian.'

EDITH PETTEE, Detroit: 'Plant Distribution in a Small Bog.'

ALFRED DACHNOWSKI, Ann Arbor: 'Ravines in the Vicinity of Ann Arbor.'

H. S. REED, University of Missouri, Columbia, Mo.: 'History of Ecological Work.'

J. B. POLLOCK, Ann Arbor: 'A Species of *Hormodendrum* Parasitic on the Araucaria.'

S. ALEXANDER, Ann Arbor: 'A Southern Plant, New to the Flora of Michigan, Found Growing at Ann Arbor.'

SECTION OF GEOLOGY AND GEOGRAPHY.

Vice-President, M. S. W. Jefferson, Ypsilanti.

S. ALEXANDER, Ann Arbor: 'A Remarkable Floral Reversion Caused by Bud-Grafting.'

E. L. MOSELEY, Sandusky, O.: 'Changes of Level at the West End of Lake Erie.'

FRANK B. TAYLOR, Fort Wayne, O.: 'Relation of Lake Whittlesey to the Arkona Beaches.'

EDWARD H. KRAUS, Ann Arbor: 'Occurrence and Distribution of Celestite-bearing Rocks.'

W. H. SHERZER, Ypsilanti: 'Glaciers of British Columbia.'

I. C. RUSSELL, Ann Arbor: 'Drumlin Areas in Northern Michigan.'

FRANK LEVERETT, Ann Arbor: 'Interglacial Lake Clays of the Grand Traverse Regions.'

M. S. W. JEFFERSON, Ypsilanti: 'Beach Cusps.'

EDWARD H. KRAUS, Ann Arbor: 'Origin of the Sulphur Deposits at Woolmith Quarry, Monroe Co., Mich.'

SECTION OF SANITARY SCIENCE.

Vice-President, T. B. Cooley, Ann Arbor.

V. C. VAUGHAN, Ann Arbor: 'The War Against Tuberculosis.'

F. G. NOVY, Ann Arbor: 'Bird Hematozoa.'

HENRY B. BAKER, Lansing: 'Am I My Brother's Keeper?'

CRESSY L. WILBUR, Lansing: 'The Scientific Necessity of Complete Registration of Vital Statistics.'

W. G. SACKETT, Agricultural College: 'The Relation of Bacteria to Plant Food.'

S. F. EDWARDS, Ann Arbor: 'Tryptophan Media.'

L. T. CLARK, Agricultural College: 'Technical Cultural Manipulation of Rhizobium.'

H. N. TORREY, Ann Arbor: 'Staining by the Romanowsky Method.'

BRONSON BARLOW, Guelph, Ont.: 'The Steam Still.'

W. R. WRIGHT, Agricultural College: 'The Relation of the Bacterial Content to the Ripening of Michigan Cheese.'

T. B. COOLEY, Ann Arbor: 'Some Bacterial Hemolysins.'

V. C. VAUGHAN, JR., Ann Arbor: 'The Action of the Intra-Cellular Poison of the Colon Bacillus.'

Sybil May Wheeler, Ann Arbor: 'The Extraction of the Intra-Cellular Poison of the Colon Bacillus.'

Mary Wetmore, Agricultural College: 'The Germicidal Action of Fruit Juices upon Certain Pathogenic and Non-Pathogenic Bacteria.'

James C. Cumming, Ann Arbor: 'Disinfection by Means of Formalin and Potassium Permanganate.'

Charles E. Marshall, Agricultural College: 'Bacterial Products in Milk and Their Relation to Germ Growth.'

SECTION OF SCIENCE TEACHING.

Vice-President, W. H. Sherzer, Ypsilanti.

I. B. Meyers, School of Education, University of Chicago: 'Elementary Field Work—Aims and Methods.' Discussion opened by L. H. Bailey, Cornell University.

M. S. W. Jefferson, State Normal College: 'Aims and Methods of Physiographic Field Work in Secondary Schools.' Discussion opened by R. D. Calkins, Central Normal School.

C. E. Adams, University of Michigan: 'Aims and Methods of Zoological Field Work in Secondary Schools.' Discussion opened by Miss Jessie Phelps, State Normal College.

H. C. Cowles, University of Chicago: 'Aims and Methods of Botanical Field Work in Secondary Schools.' Illustrated with lantern. Discussion opened by E. L. Moseley, Sandusky High School, Ohio.

J. Harlan Bretz, Albion College: 'Field Work in Botany for the Winter Season.'

SECTION OF ZOOLOGY.

Vice-President, Raymond Pearl, Ann Arbor.

J. E. Duerden, Ann Arbor: Natural History Notes from the Hawaiian Islands—'Role of Mucus in Corals,' 'Commensalism of Crab and Actinian.'

Hubert Lyman Clark, Olivet College: 'The Value of the Pedicellariæ in the Taxonomy of Sea-urchins.'

L. Murbach, Detroit: 'The Static Function in Some Crustacea.'

Miss Jean Dawson, Ann Arbor: 'An Ecological Study of Physa.'

S. O. Mast, Hope College: 'Light Reactions of Stentor.'

S. J. Holmes, Ann Arbor: 'The Reflex Theory of Phototaxis.'

C. C. Whittaker, Olivet College: 'Variation in the Blue Racer.'

Miss S. A. Ayres, Ann Arbor: 'The Nervous System of *Cœnopsammia*.'

Raymond Pearl and Frances J. Dunbar, Ann Arbor: 'Some Results of a Study of Variation in Paramecium.'

A. B. Clawson, Ann Arbor: 'Some Results of a Study of Correlation in the Crayfish.'

J. E. Duerden, Ann Arbor: 'Demonstration of Hawaiian Corals.'

The University Museum Expedition to Northern Michigan—Charles C. Adams, Ann Arbor: 'Introductory Remarks.' A. G. Ruthven, Ann Arbor: 'An Ecological Survey in the Porcupine Mountains and Isle Royale.' Otto McCreary, Ann Arbor: 'Ecological Distribution of the Birds of the Porcupine Mountains.' Bryant Walker and A. G. Ruthven, Detroit and Ann Arbor: 'Annotated List of the Molluscs of the Porcupine Mountains and Isle Royale.' N. A. Wood, M. M. Peet and O. McCreary, Ann Arbor and Ypsilanti: 'Annotated List of the Birds of the Porcupine Mountains.' N. A. Wood, M. M. Peet and O. McCreary, Ann Arbor and Ypsilanti: 'Annotated List of the Birds of Isle Royale.'

Bryant Walker, Detroit: 'The Distribution of Polygyra in Michigan.'

Frank N. Notestein, Alma College: 'The Ophidia of Michigan.'

Morris Gibbs, Olivet College: 'A Summary of the Work Hitherto done on Michigan Herpetology.'

Hubert Lyman Clark, Olivet College: 'The Distribution of the Blue Racer and Rattlesnake in Michigan.' (With maps.)

Morris Gibbs, H. L. Clark and Frank N. Notestein, Olivet College and Alma College: 'A Provisional List of the Amphibia and Reptilia of Michigan.'

The officers elected for the ensuing year are as follows:

President—W. B. Barrows, Agricultural College.

Vice-Presidents of Sections—Agriculture, Professor W. J. Beal, Agricultural College; botany, Professor J. B. Dandeno, Agricultural College; geography and geology, Mr. Frank Leverett, Ann Arbor; sanitary science, Dr. V. C. Vaughan, Jr., University of Michigan; science teaching, Professor E. N. Transeau, Alma College; zoology, Dr. J. E. Duerden, University of Michigan.

Librarian—Dr. G. P. Burns, University of Michigan.

Secretary-Treasurer—Professor C. E. Marshall, Agricultural College.

F. C. Newcombe.

THE TORREY BOTANICAL CLUB.

A REGULAR meeting was held on April 11, at the American Museum of Natural History, President Rusby in the chair and twenty-two additional members present.

The paper of the evening was on 'Some Edible Seaweeds,' by Professor H. M. Richards.

After reference to the indirect importance of plankton organisms as a source of food for animal life in the sea the speaker referred to those forms of algæ which are used directly by man as foodstuffs. They were grouped roughly under four heads—blue-green, grass-green, brown and red algæ.

In the first group, specimens of a form much prized by the Chinese were shown, which is, according to good authority, *Nostoc commune flagelliforme*. This becomes highly gelatinous when soaked in warm water and is used as a thickening or sauce. A Japanese form, 'Su-zen-ji-nori,' of more doubtful nature, but probably an Aphanothece, was also shown.

Among the grass-green forms mention was made of various species of *Ulva* and *Enteromorpha*, which in dried form go under the name of 'laver' in the British isles and 'ao-nori' among the Japanese.

Among the brown forms only one of the Fucaceæ was mentioned as an article of food, namely *Durvillea utilis*, which is said to be eaten by the natives in certain parts of Chili.

The *Laminaria* forms, however, include a large number of edible species. *Alaria esculenta*, common both here and in Europe, was at one time eaten occasionally in the occident. At the present time the Japanese and Chinese make great use of these forms, indeed, after fish, they constitute the chief article of export of the Hokkaido. They are exceedingly plentiful in that region and their collection and preparation for market is a thriving business. In this connection the report of Professor Miyabe and others was passed around and attention was called to the illustrations showing the mode of harvesting the seaweeds. The two most important species seem to be *Laminaria saccharina* (*Laminaria japonica*) and *Ulopteryx pinnatifida* (presumably identical with *Undaria distans* more recently separated by Miyabe and Okamura), which are known under the respective names of 'Kombu' and 'Wakame' by the Japanese. Many other forms are eaten, however.

After reference to the well-known examples 'Irish moss' (*Chondrus crispus*) and 'dulse,' it was said that the two types most used are the delicate *Porphyra* forms and the more massive cartilaginous kinds, such as various *Gigartina, Gelidium, Gloiopeltis* species. *Porphyra* has also been eaten by Europeans and is said to be used by the natives in parts of Alaska, but it is most highly prized by the Japanese and Chinese. Under the name of 'asakusa-nori' it is put up in neat tin boxes and largely sold in the Tokio markets, it being used by itself or for thickening, giving, as it does, a very glutinous mixture with hot water. 'Fu-nori,' used chiefly as we use starch, is a mixture of species of *Gloiopeltis* and *Endotrichia*, and, like all these forms, is sold dried.

The speaker referred to agar-agar, which, on Wiesner's authority, is said to come from different species in different regions. That of Ceylon is from *Gracilaria lichenoides*, that of Java from *Eucheuma spinosum*, while the Japanese variety is furnished by *Gelidium corneum* and *cartilagineum* and *Gloiopeltis tenax*. Agar, in addition to its uses as a culture medium in bacteriological research, is said to be employed sometimes as an adulterant in the jellies of commerce, where it may be recognized by the siliceous frustules of diatoms, etc., from which it is never free.

Other forms of Florideæ are used as foodstuffs, attention being called to their figures in a Japanese popular work on the useful plants of Japan.

In regard to the food value of algæ it appears that many of them, especially the blue-green forms, contain a very high percentage of proteids, though not much else of value. The gelatinifying substances obtained from the red forms appears to be a substance called gelose, which is similar to, or identical with, the pectic substances so commonly found either deposited in the middle lamella of the cells of higher plants, or in the walls themselves. Mention was incidentally made of the

use of seaweeds in the manufacture of iodine and soda-ash. Dr. Rusby exhibited specimens of *Fucus vesiculosus* and an unnamed form, which are used medicinally.

Dr. Howe spoke of dulse as an article of food and of its occurrence in the markets of New York.

After further discussion, adjournment followed.

L. H. Lighthipe,
Secretary pro tem.

THE AMERICAN MATHEMATICAL SOCIETY.

A regular meeting of the society was held at Columbia University on Saturday, April 29. On the preceding Saturday the Chicago section met at the University of Chicago. The two sessions of the New York meeting were attended by thirty-eight members. President W. F. Osgood occupied the chair, being relieved by Vice-President E. W. Brown and the secretary. The following new members were admitted: J. H. Grace, Peterhouse, Cambridge, Eng.; H. B. Leonard, University of Chicago; R. B. McClenon, Yale University; W. S. Monroe, Columbia, Mo.; J. C. Morehead, Yale University; Henri Poincaré, University of Paris; R. G. D. Richardson, Yale University; Miss S. F. Richardson, Vassar College; F. R. Sharpe, Cornell University; Miss M. S. Walker, University of Missouri. Six applications for membership were received. The total membership of the society is now 490, including 34 life members.

An appropriation of $100 was made toward binding the rapidly accumulating library material. The catalogue of the library now includes nearly 2,000 volumes, accessions amounting to some 500 volumes per annum. The greater part of the expense of binding is borne by the Columbia University Library, in which the collection is deposited.

The society has recently issued, through The Macmillan Company, an octavo volume of 175 pages containing the lectures on mathematics delivered at the Boston colloquium, September, 1903, by Professors E. B. Van Vleck, H. S. White and F. S. Woods.

The following papers were read at the April meeting:

Arthur Schultze: 'Graphic solution of quadratics, cubics and biquadratics.'

Max Mason: 'On the derivation of the differential equation of the calculus of variations.'

D. R. Curtiss: 'Theorems converse to Riemann's on linear differential equations.'

Virginia Ragsdale: 'On the arrangement of the real branches of plane algebraic curves.'

J. C. Morehead: 'Numbers of the form $2^k q + 1$ and Fermat's numbers.'

E. B. Van Vleck: 'Supplementary note on theorems of pointwise discontinuous functions.'

James Pierpont: 'Inversion of double infinite integrals.'

James Pierpont: Multiple integrals (second paper.'

R. B. McClenon: 'On simple integrals with variable limits.'

E. O. Lovett: 'On a problem including that of several bodies and admitting of an additional integral.'

M. B. Porter: 'Concerning Green's theorem and the Cauchy-Riemann differential equations.'

M. B. Porter: 'Concerning series of analytic functions.'

J. E. Wright: 'Differential invariants of space.'

Edward Kasner: 'On the trajectories produced by central forces.'

E. B. Wilson: 'Sur le groupe qui laisse invariant l'aire gauche.'

E. J. Wilczynski: 'Projective differential geometry.'

I. M. Schottenfels: 'On the simple groups of order 8!/2' (preliminary communication).

I. M. Schottenfels: 'Certain trigonometric formulas for the quantity $x + \epsilon y$, where $\epsilon^2 = 0$.'

Edward Kasner: 'A theorem concerning partial derivatives of the second order, with applications.'

J. E. Wright: 'On differential invariants.'

L. P. Eisenhart: 'Surfaces of constant curvature and their transformations.'

L. E. Dickson: 'On the class of the substitutions of various linear groups.'

Josiah Royce: 'The fundamental relations of logical and geometrical theory.'

The summer meeting of the society will be held at Williams College, Williamstown, Mass., on Thursday and Friday, September 7–8. The San Francisco section will also meet in September.

F. N. Cole,
Secretary.

DISCUSSION AND CORRESPONDENCE.

MARINE ZOOLOGY IN THE HAWAIIAN ISLANDS.

TO THE EDITOR OF SCIENCE: At a time when zoologists are making their plans for summer vacation work it seems opportune to direct attention to the advantages offered even in such a distant territory as the Hawaiian Islands. During a visit to the islands last year, under the auspices of the Carnegie Institution, for the purpose of studying the living corals, I was afforded the privileges of the public aquarium recently established near Honolulu, and the directors of the institution desire it to be known that they will be prepared to accord a similar courtesy to other zoologists visiting the islands for purposes of research.

The aquarium is a modest structure, erected a little over a year ago, and is under the control of the Rapid Transit Company, though the funds were largely provided by the generosity of different gentlemen interested in the welfare of the islands. It is most advantageously situated at Waikiki Beach, a suburb of Honolulu, and the adjacent coral flats constitute most favorable collecting ground. Though no special appliances beyond exhibition and experimental tanks are available, yet the advantages of these and a constant supply of sea-water appeal to any student desirous of carrying out investigations on living forms. Moreover, with a generosity which is very praiseworthy, the directors are prepared to make whatever reasonable adaptations may be required.

Our knowledge of the marine fauna of the Hawaiian Islands is becoming rapidly extended, mainly through the reports on the collections made by the U. S. Fishery Bureau, under the direction of President D. S. Jordan, during the two successive seasons, 1901 and 1902. The large addition to the number of species of fishes alone shows how very desirable was such faunistic work, and other groups are yielding a corresponding number of new forms. The physical conditions of the coral reefs have been studied in part by Professor A. Agassiz. Though the luxuriance of the life on the reefs does not equal that in the more distant Tahiti, Samoa, or the Philippine Islands, yet there is sufficient, particularly in such places as Kaneohe Bay, to satisfy the most ardent investigator.

For the student of terrestrial forms the islands are particularly interesting on account of the influence of introduced animals and plants upon an indigenous fauna and flora. Representatives from the east and from the west, from temperate and from tropical regions, here flourish, and against the pests a strong corps of entomologists is engaged in further introduction of possible remedial forms. The fact that the land shells of the islands served to supply the Rev. J. T. Gulick with material for the theory of isolation adds an interest to the evolutionary biologist. The ethnology and various departments of natural history are well cared for by Professor T. H. Brigham, of the Bishop Museum, and his staff of assistants.

As a last word of attraction regarding the situation of the aquarium one may quote from the 'Report on Collections of Fishes made in the Hawaiian Islands' by Professor O. P. Jenkins:

> Of all situations about the island of Oahu, the submerged reef which extends from the entrance of the harbor of Honolulu to some distance past Waikiki furnishes the most prolific supply of fishes, both as to number of species and amount of the catch. This reef at low water is from a few inches to a few feet under water and extends from one mile to two or three miles from the shore, where the water abruptly reaches great depths. Over the surface and along the bluff of this reef may be found representatives of most of the shore fauna of the Hawaiian Islands. This reef, so favorably situated, so accessible, and so rich in material, can not fail to be of increasing interest to naturalists who may have the good fortune to devote themselves to the study of its wonderful life.

J. E. DUERDEN.

RHODES UNIVERSITY COLLEGE,
GRAHAMSTOWN, CAPE COLONY.

THE GREENE EXPLORING EXPEDITION.

TO THE EDITOR OF SCIENCE: The W. C. Greene Exploring Expedition consisting of Robert T. Hill, John Seward, Frank H.

Fayant and E. O. Hovey has finished its first exploration of the northern part of the Western Sierra Madre Mountains of Mexico. A summary account of the first half of the trip, from El Paso to Guaynopita, has been given to the readers of SCIENCE. The second half of the journey was no less interesting than the first and was fully as productive of scientific observations.

Leaving Guaynopita by pack train on March 11, the first stage of the journey was the climb of 3,500 feet out of the Yaqui (Aros) cañon in which Guaynopita is located on to the great mesa out of which the mountains of the region have for the greater part been carved. The contrast in vegetation between different parts of this section may be illustrated by the statement that fan-leaf palms flourish in the gorges near the river, while on the high mesa one finds the great long-leaf sugar pine predominant.

Our course lay southward for sixty or seventy miles along the broad plains and narrow divides forming the mesa, or connecting different parts of it, and we had abundant opportunity of studying the topography of the great Tutuaca Cañon, which is tributary to the Yaqui (Aros), and of observing the contest for the drainage of the plateau between the streams flowing to the west and those flowing to the east. The dissection of the plateau is more pronounced toward the west, and our cross-section of the cañon of the Tutuaca River from its eastern boundary at the edge of the Mesa Venado disclosed acid and basic lavas, tuffs, agglomerates and conglomerates through six thousand feet of beds. The western rim of the Tutuaca Cañon is near the important Dolores mineral district. Some of the extensive igneous action has been accompanied and followed by strong mineralization of veins. At Dolores a fifteen-stamp mill of the most up-to-date construction is just being completed under the supervision of Manager J. Gordon Hardy for the treatment of the rich gold and silver ores of the Alma Maria vein by the direct cyanide process.

Near Dolores we turned southward again and pursued our course along a series of high mesas, divides, arroyos and river channels until we reached the little Indian town of Yepachic. In this part of our route we passed through three or four fertile ranches and at Yepachic found the people (Tarahumares and Pimas) living for the most part from the tillage of a small alluvial plain surrounded by low mountains. Here we turned westward again and within a few miles reached the Cerro Boludo (Bald Mountain) district, which, like several others on our route, is characterized by a mineralized quartz vein twenty to eighty feet wide which can be seen traversing hill and vale for miles.

Six or eight miles south of Cerro Boludo lies the little Mexican camp of San Francisco, where a diminutive two-stamp mill feeds a primitive arrastra as a preliminary to pan amalgamation of the gold. Thence the Ocampo trail leads over a divide and across the deep cañon of the Rio de Mayo, down into and out of the Rosario arroyo before the great arroyo is reached in the bottom of which, at the junction of two branch arroyos, is crowded the mining camp of Ocampo—a place better known by its old name of Jesus Maria. This is the site of many rich gold and silver mines, the most famous of which is the Santa Juliana.

From Ocampo to Miñaca, 100 miles, the trail crosses the high mesa, which has a gentle slope eastward and is partly dissected by comparatively shallow cañons of varying depths. Miñaca, the present terminus of the Chihuahua and Pacific Railway, is in a beautiful broad basin about 7,000 feet above tide, which is traversed by the headwaters of the Rio Verde, a tributary of the Yaqui (Aros) River.

At Miñaca our party took train for Chihuahua and thence went by rail to El Paso, completing our noteworthy circuit in the western Sierra Madre Mountains of northwestern Mexico. The circuit was not very long, compared with the mileage of some expeditions, but the results along lines of physiographic, dynamic and economic geology are of importance and will be published as soon as they can be put into proper shape, while the photographs taken illustrate as completely as prac-

ticable the phenomena observed. Among others the problems of buried mountains, bolsen deserts, mesas and the structure of the western Sierra Madres have had much new light thrown upon them, if they have not been solved. EDMUND OTIS HOVEY.

NEWSPAPER SCIENCE.

TO THE EDITOR OF SCIENCE: In the interest of the dignity of scientific research I wish to repeat the statement, made by me on a former occasion, that I have not authorized the sensational reports concerning any work; and that I am in no way responsible for the idiosyncrasies of our daily press.

JACQUES LOEB.

BERKELEY,
May 27, 1905.

A BIOGRAPHICAL DIRECTORY OF AMERICAN MEN OF SCIENCE.

THE undersigned is compiling a 'Biographical Directory of American Men of Science.' It was begun as a manuscript reference list for the Carnegie Institution of Washington, but arrangements have now been made for its publication. The book should be ready in the autumn, nearly 4,000 biographical sketches being in type. The proofs have been corrected by those concerned, but in order to secure as great accuracy as possible a revised proof will be sent in the early autumn.

This letter is written with a view to securing biographical sketches from those living in North America who have carried on research work in the natural or exact sciences but who have not received proof of a sketch for correction. Some of those who were asked to send the information required did not reply even in answer to a second and third request, and there are, of course, many who should be included in the work but who for one reason or another did not receive the request for information.

It is intended that each biographical sketch shall contain information, as follows:

1. The full name with title and mail address, the part of the name ordinarily omitted in correspondence being in parentheses.
2. The department of investigation given in italics.
3. The place and date of birth.
4. Education and degrees with dates.
5. Positions with dates, the present position being given in italics.
6. Temporary and minor positions.
7. Honorary degrees and other scientific honors.
8. Membership in scientific and learned societies.
9. Chief subjects of research, those accomplished being separated by a dash from those in progress.

The undersigned will be under great obligations to those men of science who will send him biographical sketches of themselves or who will secure sketches from those who should be included in the work—those who live in the United States, Canada, Newfoundland, Mexico or Cuba, and who have contributed to the advancement of one of the following sciences: mathematics, astronomy, physics, chemistry, geology, botany, zoology, pathology, physiology, anatomy, anthropology, psychology.

The compiler of the book hopes that any assistance given him to make it as complete and accurate as possible will be at the same time a contribution to the organization of science in America.

J. MCKEEN CATTELL.

GARRISON-ON-HUDSON, N. Y.

SPECIAL ARTICLES.

THE NOMENCLATURE OF TYPES IN NATURAL HISTORY.

PRACTICAL work in the arrangement and cataloguing of 'types' and other museum material has shown us that the present nomenclature is not yet sufficient for critically distinguishing all the different classes of such specimens. Further, some of the terms which have been proposed for the purpose are already employed in other ways: for instance, *homotype* is in use in biology; *monotype* is the name of a printing machine; *autotype* is the term for a printing process. We wish, therefore, to submit the following system of nomenclature; and we hope that, in making it more complete, we have provided a scheme which will render efficient service in the labeling and registration of types and typical material.

The terms printed in broad-faced letters are the additions or modifications for which we are at present responsible. A fuller explanation of all the terms will be found in the 'Catalogue of the Type and Figured Specimens of Invertebrate Fossils in the U. S. National Museum,' a work which has been prepared by Charles Schuchert and is now passing through the press; and the present article gives a synopsis of the terms which it has been found necessary to use in connection with that and similar work.

We now make another suggestion. After the different terms we have placed, in brackets, the contractions which we propose should be used in the actual marking of small specimens to which it is impossible or inadvisable to affix the full label. Our plan for such contractions is this: For types of the first class, two capital letters; for those of the second class, one capital and one small letter; for typical specimens, two small letters.

In the definitions which follow, the term 'description' indicates either a description by words, or by a picture, or by both combined. For the sake of accuracy we suggest that the original description by words (type-description) be called the **protolog,** the original description by a picture (type-figure), the **protograph.** It is obviously more easy to identify actual types from the latter than from the former.

Primary types **Proterotypes.** Material upon which original descriptions of species are based.

Holotype [**H. T.**]. The only specimen possessed by the nomenclator at the time; the one specimen definitely selected or indicated by the nomenclator as the type; the one specimen which is the basis for a given or cited protograph.

Cotype (more properly *Syntype*) [**S. T.**]. A specimen of the original series, when there is no holotype.

Paratype [**P. T.**]. A specimen of the original series, when there is a holotype.

Lectotype [**L. T.**]. A cotype chosen, subsequently to the original description, to take the place which in other cases a holotype occupies (λεκτός, chosen, picked).

Supplementary types (**Apotypes** vice *Hypotype* in use). Material upon which supplementary descriptions of species are based.

Heautotype (vice *Autotype* in use) [**H. t.**]. Any specimen identified with an already described and named species, selected by the nomenclator himself in illustration of his species, such specimen not being identifiable as one of the proterotypes.

Plesiotype [**P. t.**] Any specimen identified with an already described and named species, but not selected by the nomenclator himself.

Neotype [**N. t.**]. A specimen identified with an already described and named species, selected to be the standard of reference in cases when the proterotypes are lost, destroyed or too imperfect for determination, such specimen being from the same locality and horizon as the holotype or lectotype of the original species.

Typical specimens (**Icotypes**) (ἐικός, what is like).* Material which has not been used in literature, but serves a purpose in identification.

Topotype [**t. t.**]. A specimen of a named species from the locality of the holotype or lectotype, in paleontology from the same locality and horizon.

Metatype [**m. t.**]. A topotype identified by the nomenclator himself.

Idiotype [**i. t.**]. A specimen identified by the nomenclator himself, but not a topotype.

Homoeotype (vice *Homotype,* preoccupied) [**h. t.**]. A specimen identified by a specialist after comparison with the holotype or lectotype (μοῖος, resembling).

Chirotype [**x. t.**]. A specimen upon which a chironym is based (chironym, a Ms. name, Coues, 1884).

In addition to the above, we have the use of the word 'type' in connection with genera—a given species is the type of the genus. The classification of such types is as follows:

TYPES OF GENERA (*Genotypes*).

Genoholotype. The one species on which a genus is founded; or a series of species on

* ἐικός, gen. ἐικότος, ειικο for ειικοτο, to make. Ico type for euphony.

which a genus is founded, the one species stated by the author to be the 'type.'

Genosyntype. One of a series of species upon which a genus is founded, no one species being the genoholotype.

Genolectotype. The one species subsequently selected out of genosyntypes to become the 'type.'

CHARLES SCHUCHERT,
S. S. BUCKMAN.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
SUMMER MEETING OF SECTION E.

SECTION E of the American Association for the Advancement of Science will hold a summer meeting at Syracuse, N. Y., July 19–22. Arrangements have been made for making the meeting enjoyable and profitable to all members of the section. The vicinity of Syracuse is one of great interest in several branches of geology: the fossiliferous rocks of the New York series are well exposed in many ravines; the surface shows most of the phenomena of chief interest in glacial geology; the preglacial and the modern topography have been worked out by specialists, and the economic geology of the district is important. The chief study in the field during the meeting will be the gorges and lakes of the glacial drainage, which are the most novel features of the district.

In making its plans for the meeting the sectional committee has accepted the cordial invitation of the committee having in charge the joint summer courses in geology for several eastern universities and colleges to hold a meeting in conjunction with the summer school.

The following program may now be provisionally announced:

Wednesday, July 19, 8.00 P.M.—The section will meet informally for the purpose of organization and of listening to short addresses by the officers of the section, the state geologist and others. Professor T. C. Hopkins, of Syracuse University, will discuss local geology.

Thursday, July 20.—Field day with picnic lunch. The section will visit the Jamesville Lakes, the 'fossil cataracts' and the several glacial stream channels in the vicinity of Jamesville and part of the shore line of Lake Iroquois in Onondaga Valley. Field addresses will be given by Professor H. L. Fairchild on 'The Local Glacial Features' and by Professor John M. Clarke on 'The New York Series, with Special Reference to the Paleontology and Stratigraphy of the Syracuse district.'

8.00 P.M.—Popular illustrated lecture by Professor H. L. Fairchild on 'Glaciation in North America with Particular Reference to the Effects of the Ice Sheet in Central New York.'

9.30 P.M.—Social meeting in the rooms of the University Club.

Friday, July 21.—Field day with picnic lunch. The party will go by trolley to Fayetteville and thence on foot to the glacial channels and lakes south and west of Fayetteville. Field address by Mr. Frank B. Taylor, 'The Great Lakes in Their Relation to Local Geology.'

8.00 P.M.—Business meeting of the section for the reading and discussion of papers.

Saturday, July 22.—To Fayetteville by trolley or by boat on the Erie Canal. Visit the Fayetteville Channel, Round and White Lakes, the Mycenæ and adjacent channel northeast of Fayetteville, Salina Shales, Manlius limestone, Helderberg limestone, Oriskany sandstone and Onondaga limestone outcrops. Field address by Professor A. W. Grabau on 'The Physical Characters and History of Some New York Foundations.'

Free discussions of all papers will be invited.

Further particulars regarding the meeting may be obtained by addressing Professor T. C. Hopkins, University, Syracuse, N. Y., or the undersigned.

EDMUND OTIS HOVEY,
Secretary Section E,
Am. Assoc. Adv. Sci.
AMERICAN MUSEUM OF NATURAL HISTORY,
NEW YORK CITY,
May 23, 1905.

PRIZE FOR A METHOD OF SETTING DIAMONDS FOR CUTTING.

CONSIDERING the fact that the setting and resetting of diamonds for cutting purposes involves the use of an alloy, consisting of tin

and lead, the handling of which has been ascertained to produce injurious effects, *i. e.*, lead-poisoning, the government of the Netherlands has decided to open a competition under the following conditions.

The government desires a medium for the setting and resetting of diamonds to be cut —which needs not necessarily be an alloy— the use of which can not produce effects detrimental to the health of those handling the same, or an elaborate project of altering the method now in use, in such a manner that no such injurious effects can be produced.

The following requirements have further to be fulfilled:

1. The medium or the method must be practicable for all sizes and shapes of diamonds in the following branches of the diamond industry, viz., brilliants, roses and so-called non-recoupés, now being cut in the Netherlands.

2. The application must be such as to be learned by the workmen, used to the present method of work, without any great difficulty, while the setting and resetting must not require more time, or considerably more time than is usual now.

3. The application and use must not entail considerable pecuniary outlay.

The Minister of the Interior has appointed a committee of experts to consider the answers submitted, and to award the prize. The answers must be written in either the Dutch, French, English or German languages, and must be accompanied by samples or objects to enable the committee to form an opinion about the practical value of the invention, as also of a legibly written address of the competitor.

The answers, and the samples or objects pertaining thereto, must be sent carriage paid, and if sent from foreign countries duty paid, before January 1, 1906, to Professor Dr. L. Aronstein, chairman of the committee, Chemical Laboratory of the Polytechnic School, Delft, Holland.

The prize to be awarded for a complete solution of the problem is six thousand florins. The committee is empowered to divide the prize among different competitors, or to partially award the prize in case of a partial solution of the problem, for instance if it is applicable to one of the above-named branches of the diamond industry. The committee is also empowered to prescribe certain conditions, to be fulfilled by the competitor, before awarding the prize.

SCIENTIFIC NOTES AND NEWS.

At the annual anniversary meeting of the Royal Geographical Society, on May 22, Sir Clements Markham resigned the presidency of the society which he has held during the past twelve years. Sir George Goldie, founder of Nigeria, was elected to the presidency, Sir Clements Markham and Colonel D. A. Johnston were elected vice-presidents.

Dr. Henry S. Pritchett, president of the Massachusetts Institute of Technology, will give the commencement address at the University of Michigan, on June 22.

Dr. Lewellys F. Barker, who is giving up the headship of the department of anatomy at the University of Chicago to accept the chair of medicine at the Johns Hopkins University, was given a dinner by his colleagues at the University of Chicago, on May 27.

M. Sébillot has succeeded M. Deniker as president of the Anthropological Society of Paris.

Lafayette College will confer the degree of Doctor of Laws on Professor Henry M. Howe, of Columbia University.

Dr. William James, professor of philosophy at Harvard University, will give a course of lectures at the University of Chicago during the summer session.

Major E. C. Carter, U. S. A., commissioner of public health for the Philippines, has been relieved and will return to Washington. Dr. Victor G. Heiser, of the U. S. Public Health and Marine Hospital Service, has been appointed commissioner of public health.

Mr. H. E. Barnhard, state chemist of New Hampshire, has been selected as the chemist for the new Indiana Laboratory of Hygiene at Indianapolis, provided for by the last legislature.

PROFESSOR RUDOLF HAUTHAL, of the Natural History Museum at La Plata, has been appointed director of the Museum at Hildesheim.

DR. W. B. WHERRY has resigned his position as bacteriologist at the Government Laboratories, at Manila, and has returned to his former position with the Rush Medical College at Chicago.

PROFESSOR OMORI, the Japanese authority on earthquakes, is going to India to make an examination of the scenes of the late Indian earthquake, more especially in the Kangra Valley.

MR. O. M. LELAND, department of civil engineering of Cornell University, will have charge of part of the field work connected with the survey about to be made to determine the boundary line between Alaska and British Columbia.

DR. LEWIS E. JEWELL, of the Johns Hopkins University, will be one of a party to observe the solar eclipse from North Africa.

DR. HUGO MÜNSTERBERG, professor of psychology at Harvard University, sailed for Germany on June 1.

DR. L. O. HOWARD, chief of the Division of Entomology, U. S. Department of Agriculture, and permanent secretary of the American Association for the Advancement of Science, sailed on June 3 for Europe. He goes first to Italy and then to Germany, his object being, more particularly, to secure information in regard to the parasites that feed on the gypsy moth and the brown-tail moth.

PROFESSOR B. M. DUGGAR, of the University of Missouri, sailed for Europe on May 20. He will attend the International Congress of Botanists at Vienna, and will spend the coming year in work at various botanical laboratories on the continent. During his absence the department of botany will be in charge of Mr. Howard S. Reed. Mr. H. L. Shantz, of the University of Nebraska, has been added to the instructing force for the coming year.

DR. IRA N. HOLLIS, professor of engineering at Harvard University, will spend next year in Geneva.

DR. A. P. BRIGHAM, professor of geology and natural history at Colgate University, will spend the summer in Europe, sailing on June 14.

PRESIDENT TAYLOR, of Vassar College, will spend next year abroad.

AT the meeting of the Paris Academy of Sciences, on May 22, M. Maquenne read an obituary notice of the late M. Duclaux.

THERE will be a civil service examination, on June 28, for the position of plant pathologist at $1,600 per annum in the Bureau of Plant Industry, Department of Agriculture.

THE board of estimate of New York City has appropriated $850,000 to begin the erection of the New Bellevue Hospital, the cost of which will be $8,500,000.

THE Food Standards Committee of the Association of Official Agricultural Chemists has been this week in session at the Great Northern Hotel, Chicago, to give final consideration to the standards for edible oils and flavoring extracts. The following members were present: Wm. Frear, of State College, Pa.; Henry A. Weber, Columbus, Ohio; Melvill A. Scovell, Lexington, Ky.; Edward H. Jenkins, New Haven, Conn.; and Harvey W. Wiley, of Washington, D. C. Before returning to Washington, Dr. Wiley will deliver the commencement address at the Oklahoma Agricultural Experiment Station at Stillwater, the subject being 'Success.'

THE International Institute of Sociology, established at Paris, of which Professor Gustav Schmoller, of Berlin, is the president, has accepted an invitation of the Sociological Society, supported by the University of London, to hold its next congress in London in July, 1906.

THE India correspondent of the *Lancet* writes: "The plague epidemic continues with unabated virulence. For the week ending April 22 54,602 deaths were recorded, as compared with 51,786 for the preceding seven days. The death-roll for 1905 promises to exceed all former records. In 1901 the total deaths from plague were returned at 273,679, in 1902 the number rose to 577,427, in 1903

it reached 851,263 and in 1904 it was 1,022,299. From January 1 of the present year up to April 15 the number of fatal cases is reported at 576,366, and it is very doubtful whether these figures tell the whole truth. Of the total of 64,214 seizures with 54,602 deaths during the week ending April 22 the Bombay presidency had 3,497 cases and 2,787 deaths; Madras, 65 cases and 65 deaths; Bengal, 4,993 cases and 4,351 deaths; the United Provinces, 18,249 cases and 16,637 deaths; the Punjab, 33,162 cases and 27,362 deaths; Burma, 183 cases and 175 deaths; the Central Provinces, 223 cases and 175 deaths; Mysore state, 50 cases and 40 deaths; Haidarabad state, 401 cases and 316 deaths; Central India, 117 cases and 84 deaths; Rajputana, 2,924 cases and 2,406 deaths, and Kashmir, 359 cases with 215 deaths. These detailed figures will show how the disease has extended over the country and the heavy mortality of the cases. The mortality is higher this week in the Punjab by 3,420, in the United Provinces by 753, in Rajputana by 200, in Burma by 20, in Kashmir by 28, in Bombay city by 132 and in Calcutta by 130. The only noticeable decrease is in the districts of Bengal, where the epidemic seems to be abating. In this area, however, the outbreak occurred earlier in the season. During the present outbreak the anti-plague serum from the Pasteur Institute in Paris has been somewhat extensively used for the treatment of cases both in Bombay and Calcutta, and, although it is early to form a definite opinion, numerous individual reports would seem to show its value.

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. Percival Lowell has established a liberally endowed fellowship, to be known as The Lawrence Fellowship, for the Department of Astronomy at Indiana University. By the terms of the endowment the fellow is appointed by the department, but the appointment is subject to the approval of the founder. A Lawrence fellow shall be given an opportunity for astronomical research at the Lowell Observatory and to prepare a thesis on some astronomical subject agreeable to the director and the fellow. Mr. John C. Duncan has received the appointment for the year 1905–6.

Dr. W. W. Keen, professor of surgery at Jefferson Medical College, has presented to that institution $5,000 to found as a memorial to his wife the Corinna Borden Keen Research Fellowship. The conditions of the fellowship are that whenever there is accumulated from the income the sum of $500 it shall be awarded to a graduate of the college.

Miami University has been offered $40,000 by Mr. Carnegie for a library building on condition that a similar sum be raised for its maintenance. It is expected that work will begin at once. The addition to Brice Scientific Hall and the woman's dormitory, Hepburn Hall, will be ready for use by the students of the summer session.

Mr. J. P. Branch, of Richmond, Va., has given $30,000 to Randolph-Macon College for a dormitory.

Colgate University has begun the erection of a Science Hall to contain the departments of geology and geography, biology and physics and the museum collections. It will be built of stone at a cost of about $90,000, the dimensions being 117 x 70 feet. It will be ready for use during 1906.

At the University of Colorado 86 degrees were conferred at the commencement exercises on June 7. The number receiving the various degrees was as follows: M.A., 9; M.S., 2; B.A., 40; B. S. (engineering), 14; M.D., 6; LL.B., 15.

John Pearce Mitchell, A.B. (Stanford), who is now studying in Berlin, has been appointed assistant in chemistry at Stanford University.

At Barnard College, Columbia University, Miss Margaret A. Reed has been appointed lecturer in zoology, and Miss Marion E. Latham, assistant in botany.

Mr. Ernest Brown, lecturer in applied mechanics in the University of Liverpool, has been appointed assistant professor in this subject at McGill University. Dr. J. W. Hickson has been appointed assistant professor of psychology and lecturer in philosophy.